Glenohumeral Joint

The GH joint is a ball-and-socket synovial joint with three rotational and three translational degrees of freedom. It has a capsule and several associated ligaments and bursae. The articulation is composed of the large head of the humerus and the smaller glenoid fossa

Glenohumeral Articulating Surfaces

The glenoid fossa of the scapula serves as the proximal articular surface for this joint. The orientation of the

The humerus is the distal segment of the GH joint. The humeral head has an articular surface that is larger than that of the proximal glenoid articular surface, forming one third to one half of a sphere.[2] As a general rule, the head faces medially, sup

with regard to the shaft of the humerus and the humeral condyles. An axis through the humeral head and neck in relation to a longitudinal axis through the shaft of the humerus forms an angle of 130° to 150° in the frontal plane (Fig. 7-22A).[2] This is commonly known as the **angle of inclination** of the humerus. In the transverse plane, the axis through the humeral head and neck in relation to the axis through the humeral condyles forms an angle that varies far more than other parameters but is usually described as approximately 30° posteriorly (Fig. 7-22B). This angle is known as the **angle of torsion.** The normal posterior position of the humeral head with regard to the humeral condyles may be termed **posterior torsion, retrotorsion,** or **retroversion** of the humerus.

✓ Coracoacromial Arch

Sub acromi arch or space

The **coracoacromial** (or **suprahumeral**) **arch** is formed by the coracoid process, the acromion, and the coracoacromial ligament that spans the two bony projections (Fig. 7-31). Often the inferior surface of the AC

Glenoid Labrum

When the arms hang dependently at the side, the two articular surfaces of the GH joint have little contact. The majority of the time, the inferior surface of the humeral head rests on only a small inferior portion of the fossa[2,32,33] (see Fig. 7-21). The total available articular surface of the glenoid fossa is enhanced by an accessory structure, the **glenoid labrum.** This structure surrounds and is attached to the periphery of the glenoid fossa (Fig. 7-26), enhancing the depth or curvature of the fossa by approximately 50%.[34,35] Although

Glenohumeral Capsule and Ligaments

The entire GH joint is surrounded by a large, loose capsule that is taut superiorly and slack anteriorly and inferiorly in the resting position (arm dependent at the side) (Fig. 7-27). The capsular surface area is twice that of the humeral head.[39] More than 2.5 cm of distraction of the head from the glenoid fossa is allowed in the loose-packed position.[5] The relative laxity of the GH capsule is necessary for the large excursion of joint surfaces but provides little stability without the reinforcement of ligaments and muscles. When the humerus is abducted and laterally rotated on the glenoid fossa, the capsule twists on itself and tightens, making abduction and lateral rotation the close-packed position for the GH joint.[40] The capsule is reinforced by the **superior, middle,** and **inferior GH ligaments,** as well as by the **coracohumeral ligament** (Fig. 7-28). However, a thin

Bursae

In part because of the confined nature and proximity of structures in the subacromial space, several bursae are associated with the shoulder complex in general and with the GH joint specifically. The presence of bursae are indicative of the potential for frictional forces between structures. Although all bursae contribute to function, the most important are the **subacromial** and **subdeltoid** bursae (see Fig. 7-27). These bursae separate the supraspinatus tendon and head of the humerus from the acromion, coracoid process, coracoacromial ligament, and deltoid muscle. The bursae

Static Stabilization of the Glenohumeral Joint in the Dependent Arm

Given the incongruence of the GH articular surfaces, the bony surfaces alone cannot maintain joint contact in the dependent position (arm hanging at the side). As the humeral head rests on the fossa, gravity acts on the humerus parallel to the shaft in a downward direction (caudally directed translatory force). This appears to require a vertical upward pull to maintain equilibrium. Such a vertical force could be supplied by muscles such as the deltoid, supraspinatus, or the long heads of the biceps brachii and triceps brachii. Basmajian and Bazant[25] and MacConaill and Basmajian[40] reported that all muscles of the shoulder complex are electrically silent in the relaxed, unloaded limb and even when the limb is tugged vigorously downward. The mechanism of joint stabilization, therefore, appears to be passive. The line of gravity (LoG) acting on the upper extremity (and extended through the humerus) creates a downward force on the humerus (and an inferiorly directed force on the humeral head). Given the magnitude of passive tension in the structures of the rotator interval capsule (superior capsule, superior GH ligament, and coracohumeral ligament) that are taut when the arm is at the side,[41,43,44] the resultant pull of both the LoG and the rotator interval capsule creates a line of force that compresses the humeral head into the lower portion of the glenoid fossa (Fig. 7-34), where the humeral head commonly sits when the arm is at the side.

In addition to the passive tension in the rotator interval capsule, two other mechanisms help provide static stability of the dependent arm. In a healthy GH joint, the capsule has an airtight seal, which produces negative intra-articular pressure. This pressure creates a relative vacuum that resists inferior humeral translation caused by the force of gravity.[45] Loss of intra-articular pressure, produced by venting the capsule or tears in

Dynamic Stabilization of the Glenohumeral Joint

The Deltoid and Glenohumeral Stabilization

The Rotator Cuff and Glenohumeral Stabilization

The supraspinatus, **infraspinatus, teres minor,** and subscapularis muscles compose the **rotator** or **musculotendinous cuff** (also referred to by the acronym **SITS**

The Long Head of the Biceps Brachii

Glenohumeral Joint Kinematics

The glenohumeral joint's three degrees of motion include flexion-extension, abduction-adduction, and medial rotation-lateral rotation. Glenohumeral joint motions without scapular motions are presented here.

ated rotator interval capsule structures), to anterior and inferior stability by limiting anterior and inferior translations of the humeral head when the arm is at the side (0° abduction) (Fig. 7-30A). The middle GH ligament contributes primarily to anterior stability by limiting anterior humeral translation with the arm at the side and up to 45° of abduction (see Fig. 7-30B). With abduction beyond 45° or with combined abduc-

K tion and rotation (see Fig. 7-30C), the IGHLC plays the
major role of stabilization.[35,42-45] With abduction, the
axillary redundancy or slack is taken up, and the IGHLC
resists inferior humeral head translations. With subsequent
humeral external rotation from an abducted
position (see Fig. 7-30D), the anterior band of the
K IGHLC fans out to provide anterior stability and resistance
to anterior humeral translation. With humeral
abduction and medial rotation (see Fig. 7-30E), the posterior
band of the IGHLC fans out and provides posterior
K stability and resistance to posterior humeral
translation.[46] In all positions of humeral abduction, the
capsule and GH ligaments tighten with rotation of the
humerus, producing tension and consequently increas-

imply a fairly complex function. As part of the rotator interval capsule, it appears to be most important in limiting inferior translation of the humeral head in the dependent arm. However, there is some indication that it may also assist in preventing superior translation, especially when the dynamic stabilizing force of the rotator cuff muscles is impaired.[48] In addition, the coracohumeral ligament is usually reported as resisting humeral external rotation with the arm adducted.